GUIDED DATA PRESENTATION

BACKGROUND OF THE INVENTION

The present invention relates to data storage and presentation, and more particularly, to a system and method for presenting electronically stored data in tabular form, as in spreadsheets and flowsheets. A major objective is to improve presentation and review of time-varying medical data.

Electronic storage and presentation of data have improved many aspects of modern life, including medicine, by facilitating data review and manipulation. Efficient data accessibility contributes to accurate diagnosis and monitoring, and aids in treatment. Compilation of data about patient conditions also contributes to medical research and can provide information leading to breakthroughs in treatment and cures of diseases.

Information about a patient is commonly entered on a flowsheet consisting of a collection of times (independent variables) with an associated set of measurements (dependent variables) arranged in a matrix. By comparing earlier readings with later readings, changes in the patient's condition can be monitored. A matrix of data relating to a patient's physical condition can consist of a few data entries in a largely empty matrix. Alternatively, the matrix may be full, but the user may be interested in reviewing only certain measurements. For example, when a patient enters a hospital for diagnosis or treatment, information is commonly gathered relating to blood pressure, heart rate, or blood constituents such as blood sugar, oxygen, carbon dioxide, or hemoglobin. If the physician is primarily interested in abnormal blood oxygen concentrations over time, he may wish to review only the cells containing abnormal values.

Most institutions keep patient records on paper. The practitioner can spread the records out in front of him for easy review, and can juxtapose pages to compare data. Pages can be reordered to highlight data of interest. On the other hand, under clinical conditions, the practitioner is often not able to spread the records out, and ends up flipping through a file. The file may be cumbersome, and paging back and forth can be clumsy and lead to error. Furthermore, review of paper records can take a significant amount of time.

Electronic record-keeping obviates many of the problems associated with paper records. Electronic records remain in order, allowing for quick and easy review of sequential entries. Large amounts of data can be stored and quickly searched. On the other hand, electronic data are usually presented in matrices on a cathode-ray tube (CRT) screen, so that only a single screenful, or "neighborhood", of data, can be displayed at a given time. The user must scroll back and forth to review entries in different data neighborhoods. Furthermore, although a system will often allow a user to view and compare data items that happen to be nearby in the matrix, conventional approaches do not allow the user to compare significant data items that are not nearby. The advantage of juxtaposition, allowed by paper records, can be lost in electronic presentation.

When matrix data are sparse, review of the data can involve scrolling through screen after screen of empty cells. For example, in a compilation of fields arranged by time, even if only the first and last time slots contain data entries, the user must typically check all time slots. Review of the data entries can require that the user scroll through many empty screens to glean a few entries. The repetitive scrolling can lead to fatigue and increased errors.

Successive frames on the CRT may overlap, so that presentation is redundant. When successive frames do not overlap it is often unclear whether a salient data entry has been skipped over. The neighborhood of values presented often provides insufficient context for the user. Such inconvenient presentation of data may be a further cause of fatigue and error.

Although conventional display techniques can indicate that there are cells beyond the neighborhood presented, the user has no way of knowing whether the cells are empty or whether they contain data and, if so, whether they contain data of interest. The user must scroll through an entire flowsheet to be sure that he has not overlooked any data entries. When the data in the matrix is sparse, review of empty neighborhood after empty neighborhood can be tedious and frustrating. What is needed is a method of data storage and display that enables a user to monitor data items of interest quickly and easily without fatiguing and repetitious scrolling, and that allows comparison of data entries of interest in databases, spreadsheets, and flowsheets.

SUMMARY OF THE INVENTION

In accordance with the present invention, a method of electronic data display indicates whether there are significant off-display data entries in a flowsheet. The flowsheet can be ordered according to time or another independent variable. The data entries can be values of a dependent variable which vary as a function of the independent variable. A criterion is defined for evaluating the values of the dependent variable. A display range of the flowsheet is selected for display. An off-display array of flowsheet entries is selected for evaluation. The values of the dependent variable corresponding to the off-display array of the independent variable are then evaluated to determine whether any corresponding values meet the criterion. If the criterion is met, an indicator is displayed to indicate the presence of those values. Preferably, activation of the indicator causes a new display range to be displayed, including the closest dependent variable value meeting the criterion.

A data display system in accordance with the present invention comprises a data processor, a data display means, and indicators capable of indicating the existence in storage off-display of data meeting a selected criterion. The data processor stores a flowsheet and evaluates data values in the flowsheet to determine whether they meet the criterion. When off-display values in the flowsheet meet the criterion, indicators indicate that the data are present, and, preferably, indicate the direction to scroll to bring the values on-display. More than one criterion can be used for evaluation, and the indicators can indicate the presence and direction of values meeting different criteria. Each indicator is preferably provided as a cell that contains an arrow pointing in the direction of off-screen values when there are off-screen values meeting the criterion, and that is empty (blank) when there are no off-screen values meeting the criterion.

The indicators can be activated by keyboard or, alternatively, by mouse device. Activating an indicator serves to display the next value that meets the criterion. By repeating the activation, the user can jump from one